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LINKING OF THE MINI-COMPUTER ELEKTRONIKA-1001 AND NR-9821A

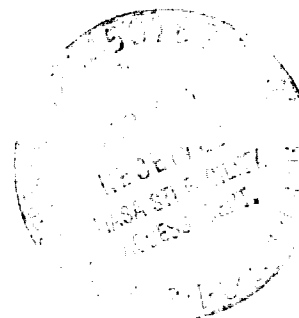
B. V. Zubkov and V. N. Khromov

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LINKING OF THE MINI-COMPUTER ELEKTRONIKA-1001 AND NR-9821A

B. V. Zubkov and V. N. Khromov
Institute of Space Research

The means of transmitting digital information from the computer / 2*
E-100I to the desk top calculator NR-9821A with the help of an intermediate carrier of information - perforated tapes - is described. Given are: the means of removal of information from the computer E-100I in a form which is understandable for the NR-9821A, instructions for the use and programming of the transcription of information onto magnetic tape from the perforated tape and from the keyboard of the calculator.

The presence of a large pool of mini-computers at the ISR makes / 3
it natural to put forth the question of creating a network of automated measurements and development of information.

Aside from other advantages, the creation of such a network makes it possible to realize a collective use of resources, in particular, of external facilities, providing an economy of resources. The first step on the way to creating the system is the connection of the various computers with the aid of information carriers. It is to this step that the present preprint is devoted, giving a description of the means of information interchange between the computer E-100I and the desk-top calculator NR-9821A.

Graphic presentation of the information concerning the results of the investigation has significant merit over tabular presentation as in the mode of operational value of information at the time of

*Numbers in the margins indicate pagination in the original text.

control of the experiment and during the development of results of the experiment.

In the case of use of the mini-computer E-100I for control of the experiment, there arises a conflict with the fact that in the complex of information input/output systems (IIOS) of the machine, neither graphic displays nor graphplotters can be entered.

For solution of the task of graphic presentation of bodies of information concerning results of an experiment, found in the memory of the computer E-100I, it was decided to do the following:

- a) develop a graphic display for operation value of information which will be described in detail in another work;
- b) to use the desk-top calculator NR-9821A for the plotting of graphs for the purpose of documentation, in complex with the graphplotter NR-9862A and perforated tape reader NR-9863A.

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For an intermediate information carrier, intended for documentation in a graphic form, perforated tape was selected, in as much, on one hand a device for reading it- NR-9863A- exists, and on the other hand - a system for its reception - perforator PL-150 (entering into the mandatory complex IIOS of the machine E-100I).

Thus, for solution of the task of graph plotting it was necessary to develop:
a means of information output from the computer E-100I to perforated tape in a form which is understandable for the reader NR-9863A;
a program of information input from the perforated tape to the calculator NR-9821A;

programs of graph plotting which will be described in another work.

It was decided to output information to the perforated tape by separate bodies, i.e. separate body X, separate body Y_1 , separate body Y_2 and so forth. Such a method makes it possible for one body X to have a various number of bodies Y.

Each of the output bodies consists of four parts:

- a) title of the body
- b) immediately the body of numbers;
- c) the control sum of the body;
- d) end symbol of the body.

Let us examin in detail the purpose of each part of the body.

a) the title of the body is used for identification of the bodies. / 5
It is necessary to bear in mind, however, that deciphering of the body titles may be done only with the listing of the perforated tape in the information input/output system (IIOS) of the machine E-100I in an automatic mode of operation. The reader NR-9863A does not accept the title since special symbols are used for the designation of the beginning and end of the title. The title of the body may contain any reasonable number of symbols. Use of any symbols (letters, numbers, punctuation marks and so forth) is allowed except parentheses. Parentheses are used only for bounding the title of the body and therefore appear as special symbols. Any information which is included within the parentheses is transmitted without record to the memory of the NR-9821A.

b) Immediately the body consists of numbers in the format "floating point". Each number of the body must without fail be ended with a number bounding symbol. For this symbol a code of command was selected which induces the return of the carriage on the printing machine of the IIOS of the E-100I. It is necessary to note that the presence of extraneous symbols in the body, that is symbols which do not characterize the value of the number and are not number bounders, increase the length of perforated tape being received and from this point of view it is undesirable. For correct interpretation of the numbers by the calculator NR-9821A the order of the number must not exceed the boundary ± 98 .

c) The number of the control sum is distinguished from the numbers of the body by the fact that after it a bounding symbol of the body stands in place of a number bounding symbol. Calculation of the control sum is carried out in the computer E-100I directly with output of the body to perforated tape and is realized by means of summation of the absolute values of all numbers of the body. After output / 6 of all numbers of the body of information, the control sum is perforated. However, it is necessary to consider that such means of accuracy control of the output/input of information only increases the probability of detecting trouble, but does not give a full guarantee of possible trouble detection. This is caused by the following reasons:

- 1) the number in which the trouble took place may make a small contribution to the control sum and therefore the capacity of the control sum may be insufficient for detection of trouble;
- 2) with output from the E-100I an incorrect transform of the output binary digit may take place at the decimal point, so, for example, the

number 4 may be derived as 0.3999999EOI, at that time in calculation of the control sum in the E-100I this number will be derived as 4. As a result it turns out that the control sum output to the perforated tape, as a rule, does not coincide with the control sum calculated in the calculator NR-9821A with input of this perforated tape. Based on this, the program of information input from the perforated tape must incorporate the possible digression of control sums which still further complicates the detection of trouble in numbers which are small with respect to the absolute value.

d) The body is ended by a special body bounding symbol. The difference of the body bounding symbol and the number bounding symbol lies in the fact that the first produces the establishment of flag 13 in the calculator NR-9821A, and analysis of flag 13 makes it possible to make a conclusion concerning the presence of the end of the body. The body boulder may be used in the form of boundaries of bodies. In this case it is convenient to have 10 - 20 consecutively output boulder codes. Here "convenient" means an errorless placement of the tape into the reader and an ease of locating the boundary of the body on the tape.

Let us examine the particulars of receiving the perforated tape. / 7

As checking indicated, the reader NR-9863A does not produce a transverse control on the oddness of the input tape. Owing to this the output of the information body to the perforated tape may be produced in codes GOST 67 and in codes GOST 67-200. In Table 1 the codes and the symbols which correspond to them are shown, by which these codes will be interpreted by the reader NR-9863A. Table 1 holds

only for that case when the plugs on the panel of the reader NR-9863A are placed in agreement with Fig. 1. The particulars of output of each part of the body are enumerated below.

a) With output of the title of the body it is necessary to remember that it must start with a opening parenthesis and end with a closing parenthesis. If this is not done, then the numbers often entering into the title will be interpreted by the reader NR-9863A as numbers of the body.

b) Directly the body of numbers may contain, except codes (000 and 252), see Table 1, any symbols (letters, numbers, punctuation signs and so forth), however all symbols except those indicated in Table 1, will be transmitted without record into the memory of the NR-9821A. Each number must end with a number bounding symbol. If several number bounding symbols are introduced one following after another, in place of one symbol, then only the first of them will be registered.

c) Output of the control sum is distinguished from the output of the number of the body only in one feature: the number of the control sum must without fail be ended not with a code (215), but with codes (000 or 252), see Table 1.

c) The code of the body end may be code 151 or 000. It is necessary / 8 to note that between the number of the control sum and the code of the end of the body, the presence of a number boulder (code 215) is not allowed, since in an opposite case the code of the body boulder will not be registered.

Together with the bounding symbols each number occupies 15 strokes on the perforated tape, i.e. approximately 3.75 cm. The perforated tape with codes in the case of the body which consists of one number -1.234567, will have the form agreeing with Fig. 3.

For output of the body to the perforated tape, a subprogram was developed. In the developed subprogram, as also in the program of the experiment control, a standard block of a floating point is used, which enters into the complex of the furnished mathematic provision for the computer E-100I. With address to the developed subprogram of the body output, it is indicated that the address of the first register of the body is also the address of the register which contains the number of registers in the body (the quantity of numbers in the body). Here the word "Register" signifies three storage registers in which are recorded one binary number in the format "floating point". The address of the register is the address of the first of three cells of the register, i.e. the address of cell A for the number recorded in cell A, A+1, A+2. The developed subprogram is intended for the output of bodies which contain no less than 99 registers. If the indicated number N of registers of the body is fractional, then the significant numbers after the decimal point are deleted. So, for example, if $N = 5.99999$, then 5 numbers of the body will be perforated. If N is less than 1, then, despite this fact, one number will be perforated, i.e. the minimally possible dimension of the body equals 1 plus the number of the control sum of the body. In such a case if the assigned dimension of the body exceeds 99 registers, an / 2 exit from the subprogram at the error will occur. An algorithm of the developed subprogram of body output is shown in Fig. 2.

For further processing of information output to the perforated tape, it was decided to preliminarily transfer it to magnetic tape with the aid of the calculator NR-9821A, which has a built-in magnetic recorder, the reader NR-9863A and the developed program of information transfer. In as much as the necessity often arises to operate with information which is introduced not only from perforated tape, but also from graphs and a keyboard, it was decided to have various programs of information recording on magnetic tape. The programs of information processing which is preliminarily recorded on magnetic tape, will be in this case standard and will not depend on the means of input of this information into the calculator.

Two programs of information recording on magnetic tape were developed. The first program, the algorithm of which is shown in Fig. 4, and the text in Fig. 5, is intended for the transfer of information from perforated tape. The second program - with input from the keyboard of the calculator NR-9821A. The algorithm of the second program is shown in Fig. 6, the text in Fig. 7.

Instruction for the use of these programs is given in the appendix.

Instruction of the Use of the Program "Transfer of Information to Magnetic Tape from Perforated Tape"

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A. Description of Program

The program consists of four parts, the designations of which are the following:

1. Input to the memory of the calculator NR-9821A from the perforated tape the body of data (with input it is necessary to consider

TABLE 1

GOST 67 + 200 CODE	SYMBOL	Symbol NR-9821A
250	(parenthesis - opens title of body
251)	parenthesis - closes title of body
215		carriage return - number boulder
252		asterisk - body boulder
000		body boulder
260	0	significant digit of the number and order of number
261	1	significant digit of the number and order of number
262	2	significant digit of the number and order of number
263	3	significant digit of the number and order of number
264	4	significant digit of the number and order of number
265	5	significant digit of the number and order of number
266	6	significant digit of the number and order of number
267	7	significant digit of the number and order of number
270	8	significant digit of the number and order of number
271	9	significant digit of the number and order of number
256	.	period - separates whole part of the number from the fractional part
253	+	plus - sign of the number and order of number
255	-	minus - sign of the number and order of number
305	E	letter E - separates factor of number from mantissa of number

Figure 1 - Position of plugs on the panel of the reader NR-9862A.

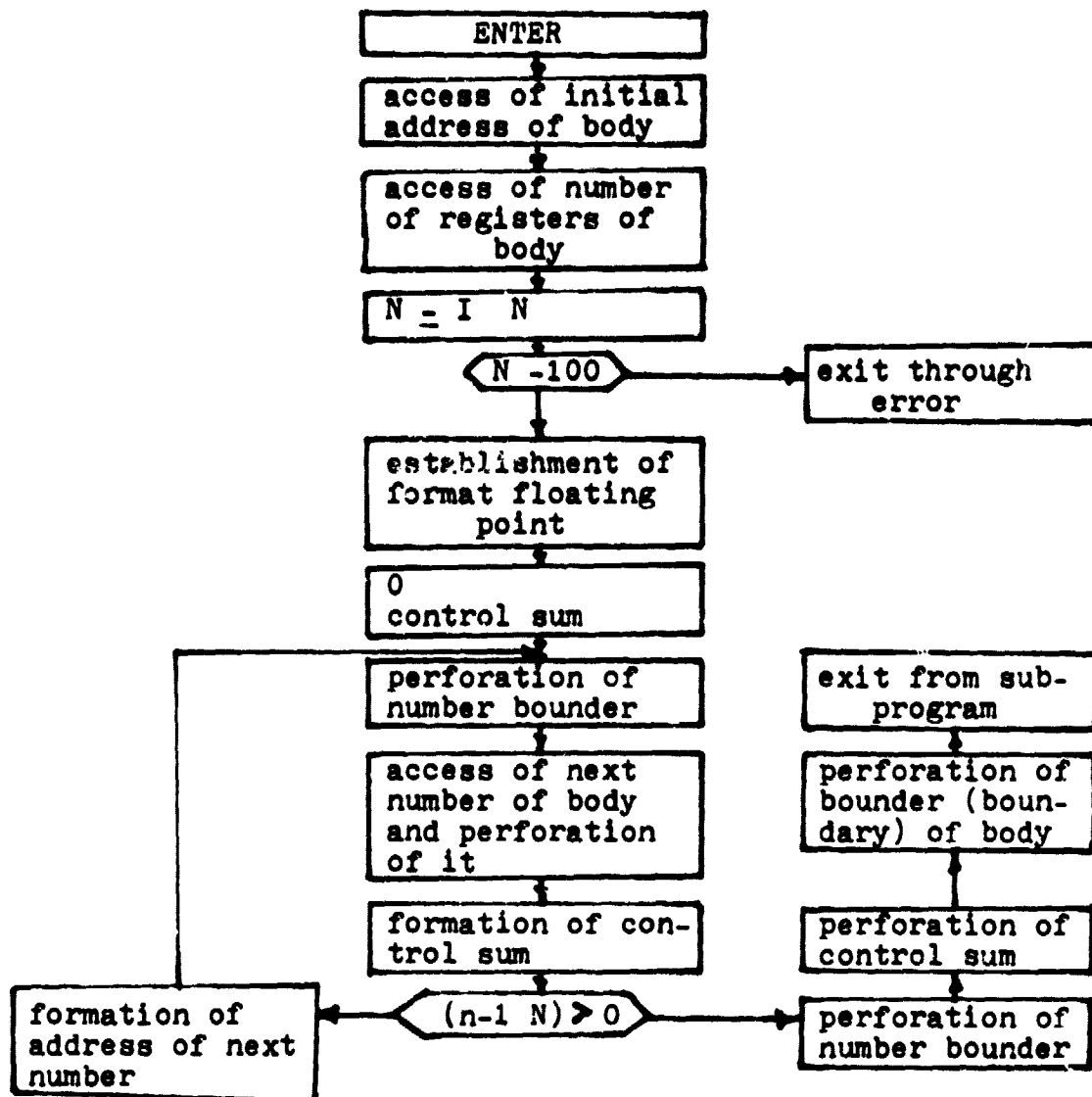


Figure 2 - Algorithm of subprogram of the perforation of the body

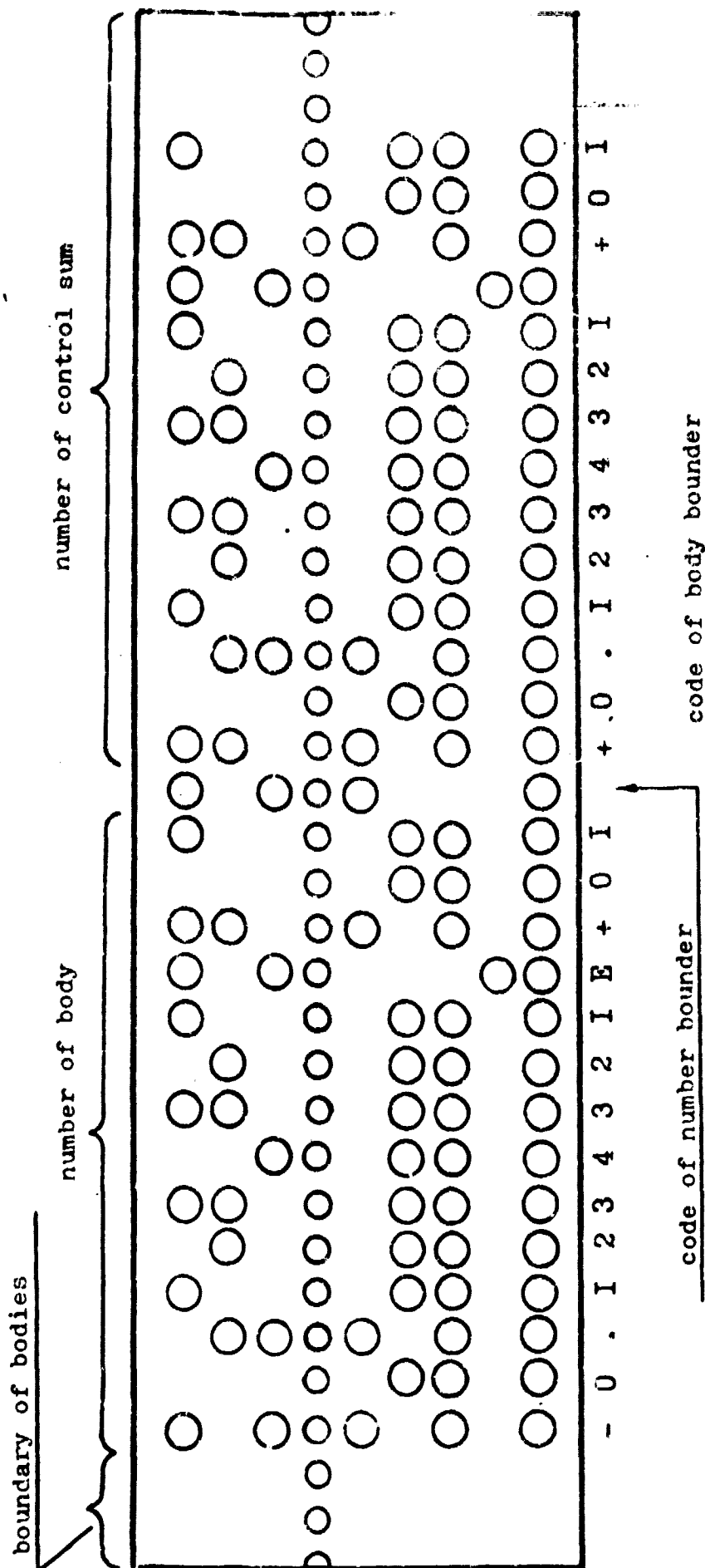


Figure 3 - Form of the perforated tape with codes. The body is perforated, consisting of one number (-0.1234321) and the control sum.

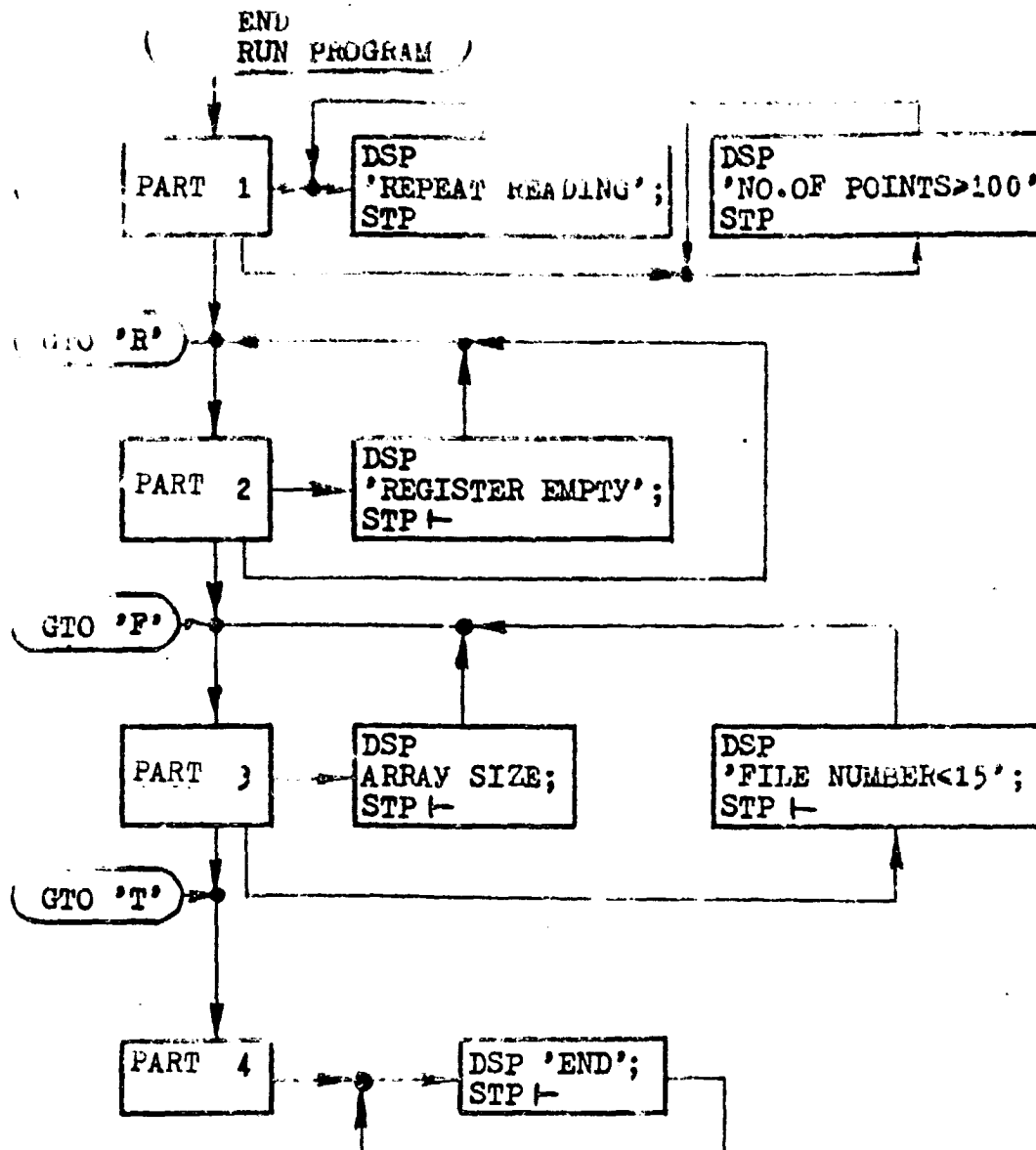


Figure 4 - Algorithm of the program "Transfer of the body from perforated tape to magnetic tape".

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10: TBL 4; 0 → B → Y; 1+1.25-0 → A †
11: IF (A+1 → A) ≤ 100; RED 7, RA; JMP 20 †
12: BEL; DSP " NO.OF POINTS > 100"; GTO 2; STP †
13: A-1 → A †
14: 1+B → B; ABS RB+Y → Y; JMP B=A-1 †
15: IF Y ≤ XRA; IF RA ≤ XY; GTO "R" †
16: BEL; DSP "REPEAT READING" ; GTO 6; STP †
17: "F" ; 0 → C; FXD 0; ENT "FILE ?", C; IF C > 15; GTO "P" †
18: IF C = 0; BEL ; DSP A-1; GTO "F"; STP †
19: BEL; DSP "FILE NUMBER < 15"; GTO "F"; STP †
20: "P"; PRT "FILE", C, "SIZE", A-1; SPC; STP †
21: RCF C, R1, R(A-1) †
22: "T"; DSP "TYPE ARRAY ?"; STP †
23: TYP; 1 → B; FMT FXD 3.0, FLT 18.9 †
24: TYP B, RB; JMP (B+1 → B) > A †
25: "N"; BEL; TYP B, Y; DSP "END"; GTO "N"; STP †
26: "R"; 0 → B; FLT; ENT "REGISTER ?", B; GTO "F"; IF B ≠ 0; GTO "I" †
27: "I"; IF B > A; BEL; DSP "REGISTER EMPTY"; GTO "R"; STP †
28: "H"; RB → Z; DSP Z; STP †
29: Z → RB; GTO "H"; IF (B+1 → B) > A; BEL; GTO "R"; DSP Y; STP †
30: END †

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Figure 5 - Text of the program "Transfer of information to magnetic tape from perforated tape".

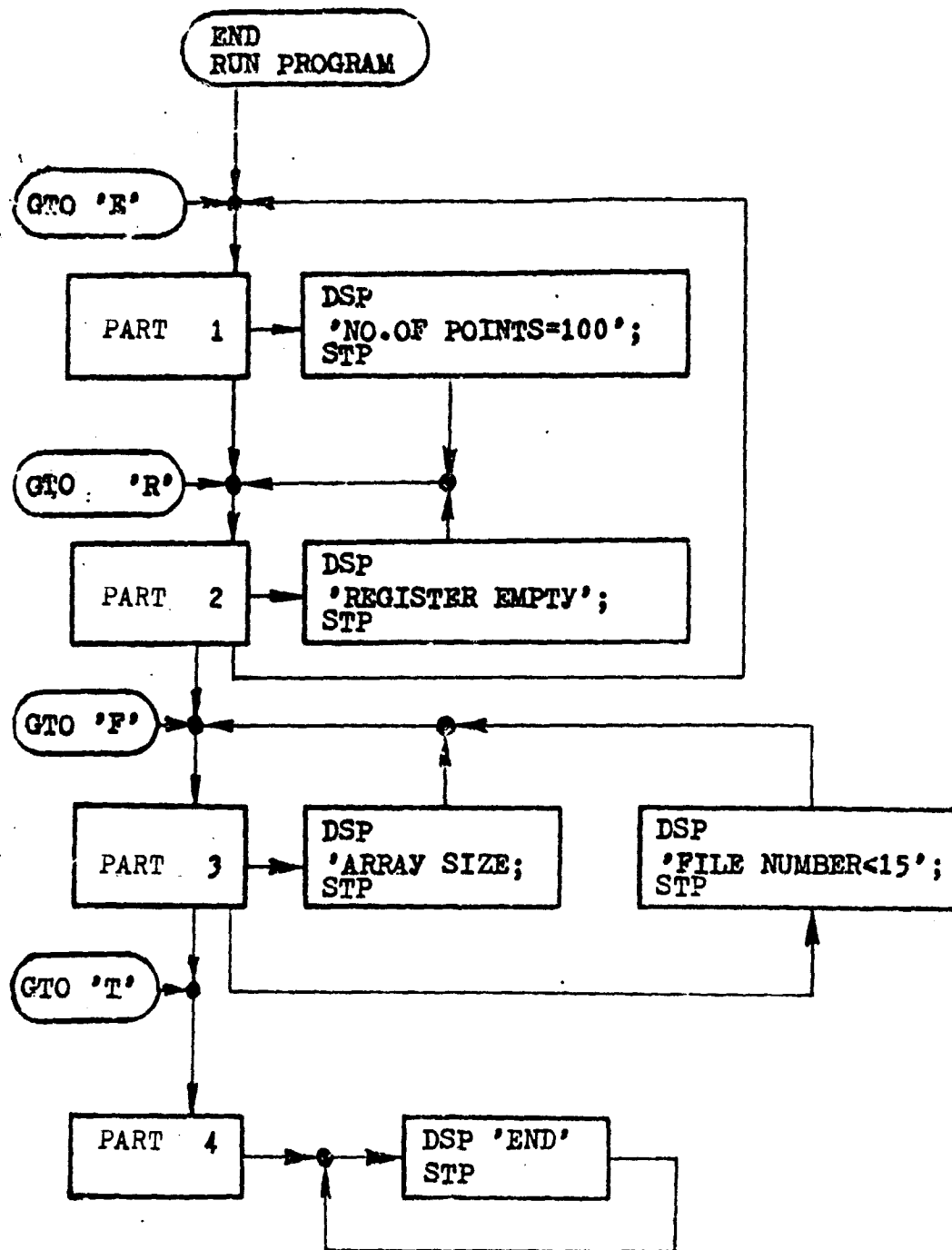


Figure 6 - Algorithm of the program "Recording of the body on magnetic tape from a keyboard".

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0: TEL 4; 0→A ⌋
1: "E" ; IF FLG 1; A-1→A ⌋
2: CFG 13; SFG 1; IF (A+1→A)≤100; ENT "VALUE ?",RA;
   CFG 1; GTO "E"; IF FLG 13; GTO "R" ⌋
3: CFG 1;A-1→A; BEL; DSP "NO.OF POINTS=100"; GTO "R"; STP ⌋
4: "F" ; IF FLG 1; CFG 1; A-1→A ⌋
5: 0→C; FXD 0; ENT "FILE ?",C; IF C>15; GTO "P" ⌋
6: IF C=0; BEL; DSP A; GTO "F"; STP -
7: BEL; DSP "FILE NUMBER≤15"; GTO "F"; STP ⌋
8: "P"; PRT "FILE",C,"SIZE",A; SPC; STP ⌋
9: RCF C,R1,RA ⌋
10: "T" ; IF FLG 1; CFG 1; A-1→A ⌋
11: DSP "TYPE ARRAY ?"; STP ⌋
12: TYP; 1→B; FMT FXD 3.0,FLT 18.9 ⌋
13: TYP B,RB; JMP (B+1→B)>A ⌋
14: "N"; DSP "END"; GTO "N"; STP ⌋
15: "R"; 0→B; FLT; ENT "REGISTER ?".B; GTO"F";IF B#0;GTO"I";
   IF FLG 1; CFG 1; A-1→A ⌋
16: "I"; IF B>A; BEL; DSP "REGISTER EMPTY"; GTO "R"; STP ⌋
17: "H"; RB→Z; DSP Z; STP ⌋
18: Z→RB; GTO "H"; IF (B+1→B)>A; BEL; GTO "E"; STP ⌋
19: END ⌋

```

Figure 7 - Text of the program "Transfer of information to magnetic tape from a keyboard".

that the program makes it possible to input bodies, the dimension of which do not exceed 100 numbers).

2. Check and correct input body;

3. Record body which is found in the memory of the NR-9821A on magnetic tape.

4. List the input body.

The program specifies both sequential completion of the parts of the program, in relation with their numbers in series, and also out-of-order completion of any part, not waiting for fulfillment of the current or following part. For example, after input of the body from the perforated tape, it is possible to print it, having turned to the fourth part. After checking, going to the third part and recording on magnetic tape.

In the process of operation of the first part, the program analyzes the quantity of input numbers. If this quantity exceeds 100 (together with the control sum), then completion of the first part is terminated and further input of perforated tape is not possible. With completion of the first part, the control sum of the body is calculated. The control sum equals the sum of the absolute values of all numbers of the body. After input of the body, a comparison is carried out of the calculated control sum with the control sum which is on the perforated tape. In the case of their noncoincidence, a signal is given for a repeat input of information. First it is possible to scan or list the input numbers, having returned to the corresponding part of the program.

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During operation with the second part it is necessary to remember that the numbers of the body will be input into the memory of the calculator NR-9821A beginning with the first register; each following number will be input into the register, the number of which is one greater than the preceding. If a scan of the contents of the memory begins from the register in which a number was not input, then the program advises of this and returns to the initial stage of fulfilling the second part. An analogous return occurs after a scan of the control sum which is input into the NR-9821A.

During operation with the third part it is necessary to indicate the number of the file in which it is required to record the body. In as much as during selection of the file, it is often desirable to know the dimension of the body, the program provides for distribution of this information. In the given program it is accepted that the files from zero to the fifteenth are occupied by the programs of processing, therefore the recording of information is permitted only in files with the number 16 and higher.

In the fourth part of the program not only is the listing of the input body produced, but also both values of the control sum. First - the control sum which is input from the perforated tape, and then the control sum which is calculated in the NR-9821A. Therefore the dimension of the listed body will be two numbers greater than the body which is intended for recording in the file.

B. Instruction for Operation with the Program

0.1. Depress the key

ERASE

Input into the memory of the calculator NR-9821A the program
"Transfer of information from perforated tape to magnetic tape".

0.2. Prepare the reader NR-9821A for operation with the program.

0.2.1. Ensure that the code of the reader selector equals 7. /20

0.2.2. Place the plugs on the panel of the reader in correspondence with Fig. 1.

0.2.3. Set the switch on the panel of the reader in the position
"DATA".

0.3. Insert the perforated tape into the reader for classification of the bodies. Move the switch position to "START". Go to fulfillment of the first part of the program.

1. Operation with the first part of the program

1.1. Successively depress the keys

END RUN PROGRAM

> With completion of this point, a clearing of the registers and filling of them with numbers is produced, the numbers being input from the perforated tape.

1.2. After the reader stops three cases are possible.

1.2.1. The display lights up the heading

NO. OF POINTS > 100

the heading is accompanied by an audio signal. It indicates that the dimension of the body on the perforated tape exceeds that allowed (for the given program).

1.2.2. The display lights up the heading

REPEAT READING

the heading is accompanied by an audio signal. It indicates a non-coincidence of the control sum of the perforated tape with the sum calculated with input and suggests the presence of trouble in the output from the computer E-100I or in the input to the NR-9821A. For repetition of input return to point 0.3.

1.2.3. If troubles in the input have not occurred, then the display lights up the heading

/21

REGISTER ?

- indicating the end of completing the first part of the program and a move to point 2.2. of the second part.

Operation with the second part of the program

2.1 For out-of-order usage of this part of the program it is necessary to depress successively the keys

STP CLEAR GTO "R" RUN PROGRAM

2.2. The display lights up the heading REGISTER ?
three variations of program continuation are possible

2.2.1. If it is necessary to move to the third part, not completing the second, depress the key

RUN PROGRAM

and go to point 3.2.

2.2.2. If it is necessary to scan the input numbers of the body, then it is necessary to type the number of the register from which it is desired to begin the scan. Let it be necessary to scan the body beginning with the 11 number. Let us type on the keyboard the number 11 and depress the key

RUN PROGRAM

go to point 2.3.

2.2.3. For out-of-order usage of any other part of the program, go to point 1. of the corresponding part. For example, for a move to the fourth part (listing of the input body), successively depress the keys (see point 4.1.)

STP CLEAR GTO "T" RUN PROGRAM

2.3. Here two cases are possible.

2.3.1. The display lights up the heading

REGISTER EMPTY

this indicates that the register that was selected is not occupied /22
by an input body. Depress the key

RUN PROGRAM

and return to point 2.2.

2.3.2. The display lights up a number which equals the contents of the selected register. Three variations of continuation are possible.

2.3.2.1. It is not necessary to change the contents of the register, in which case depress the key

RUN PROGRAM

and go to point 2.4.

2.3.2.2. In the case of the necessity of changing the contents of the register, it is necessary to type on the keyboard of the NR-9821A the necessary number which must be retained in the register, then depress the key

RUN PROGRAM

the old contents are substituted by the new. Go to point 2.4.

2.3.2.3. A scan of the contents of the registers need not be con-

tinued, but it is necessary to move to completion of some other part. For this it is necessary to turn to point 2.2.3.

2.4. At this point two cases are possible.

2.4.1. The display lights up the contents of the next register (the register with a number 1 greater than the preceding), there is no audio signal. For continuation return to point 2.3.2.

2.4.2. The display lights up the contents of the register. The display is accompanied by an audio signal. This indicates that a control sum of the body was scanned, which was input from the tape, but the display shows a control sum which is calculated in the NR-9821A. Depress the key

RUN PROGRAM

and return to point 2.2.

3. Operation with the third part

/23

3.1. For out-of-order usage of the third part of the program, successively depress the keys

STP CLEAR GTO "F" RUN PROGRAM

go to the next point.

3.2. The display lights up the heading

FILE ?

expecting the input of the number of the file selected for storage of the input body. Two variations of program continuation are possible.

3.2.1. If now, not typing on the keyboard of the NR-9821A any digit, the key depressed is

RUN PROGRAM

then, accompanied by an audio signal, a number is lit up equal to the

dimension of the input body (in the registers). It may be useful in selection of the file. Again depress the key

RUN PROGRAM

for continuation of the program return to the point 3.2.

3.2.2. If the number of the file for storage of the input body is selected, then it is necessary to type it on the keyboard of the NR-9821A. Let the dimension, for example, of the input body turn out to equal 73 registers and for this body we selected the file with the number 27.

We type on the keyboard of the NR-9821A the number 27 and depress the key

RUN PROGRAM

The system fixed in the calculator is listed

FILE 27

SIZE 73

for continuation go to point 3.3.

In the case of attempting to select a file for information storage with a number less than 16 (files with numbers from 0 to 15 store programs) a list is not produced, but the display lights up the heading /24

FILE NUMBER \leq 15

the heading is accompanied by an audio signal.

In this case it is necessary to again depress the key

RUN PROGRAM

and return to point 3.2.

3.3. After the listing of the number of the file and the dimension of the body it is still not too late to change the number of the file, if this is necessary. For this depress the keys

GTO "F" RUN PROGRAM

and return to point 3.2.

If it is not necessary to change the number of the file, depress

RUN PROGRAM

After which there occurs the recording of the body on magnetic tape, cessation of the magnetic recorder and movement to point 4.2. of the fourth part of the program.

4. Operation with the fourth part of the program

4.1. For out-of-order usage of the fourth part of the program it is necessary to successively depress the keys

STP CLEAR GTO "T" RUN PROGRAM

4.2. The display lights up the heading

TYPE ARRAY ?

4.3. Ascertain that the interface NR-11201A with the printing machine (selector code 15) is switched into the calculator. Depress, on the NR-9821A, the key

RUN PROGRAM

Printing of the body occurs.

4.4. After the printing of the input body the display lights up /25 the heading

END

The program is completed.

For input of a following body return to point 0.2.

Instruction of the Use of the Program "Recording of Information on Magnetic Tape from the Keyboard of the Calculator NR-9821A".

A. Description of the Program

The program consists of four parts, the designations of which are

the following:

1. Input into the memory of the calculator NR-9821A from a keyboard the body of data (with the input it is necessary to consider that the program makes it possible to input bodies, the dimension of which does not exceed 100 numbers).

2. Check and correct the input body.

3. Record the body found in the memory of the NR-9821A on magnetic tape.

4. Print the input body.

The program provides for both successive completion of the parts of the program in correlation with the order numbers, and also out-of-order completion of any part, not waiting for completion of the current or next part. For example, in the process of completing the first part of the program it is possible to go out of position, during which there arises the necessity of checking the numbers already input to the memory of the calculator. For checking it is possible to move to completion of the second part. After all numbers which have been input to the memory of the calculator are checked, it is possible to again go to the first part and input the remaining numbers of the body.

In the process of operation of the first part of the program, the /26 quantity of input numbers is analyzed. If their quantity becomes equal to 100, then completion of the first part is terminated and further input of numbers of the body is not possible. In this case, as in the case where all numbers of the body are input, it is possible to go to completion of the second part of the program.

During operation with the second part it is necessary to remember that the numbers of the body will be input into the memory of the calculator NR-9821A beginning with the first register; each following number will be input into the register, the number of which is one greater than the preceding. If a scan of the contents of the memory will begin with a register in which a number has still not been input, then the program advises of this and returns to the starting stage of completion of the second part. After the scan of all numbers of the input body, an audio signal is given and return to the first part of the program takes place. After completion of operation with the first part of the program, completion of the second part may be omitted.

During operation with the third part it is required to indicate the number of the file in which it is necessary to record the body. In as much as during selection of the file it is often necessary to know the dimension of the body, the program provides for distribution of this information. In the given program it is accepted that the files from zero to fifteen are occupied by processing programs, therefore recording of information is allowed in the files with a number of 16 and higher.

Completion of the fourth part does not require any elaboration.

B. Instruction in Operation with the Program

0.1. Depress the key

ERASE

Input to the memory of the calculator NR-9821A the program "Recording of information on magnetic tape from the keyboard".

/27

0.2. Successively depress the keys

END RUN PROGRAM

with completion of this operation a clearing of the registers occurs.
The program has moved to completion of point 1.2. of the first part.

Operation with the first part of the program

1.1. For out-of-order usage of the first part depress the keys

STP CLEAR GTO "0" RUN PROGRAM

With completion of this point it is necessary to remember that the registers not cleared of earlier input numbers and the input of new numbers will appear as a continuation of an earlier input body.

1.2. The display lights up the heading

VALUE ?

The program awaits the input of the next number of the body.

1.3. Type the number.

1.4. Depress the key

RUN PROGRAM

Two cases are possible:

1.4.1. The dimension of the body has attained 100 numbers.

The display lights up the heading

NO. OF POINTS = 100

This heading is accompanied by an audio signal. Further input of numbers is not possible. It is necessary to go to completion of point 1.5.

1.4.2. The dimension of the input body is less than 100 numbers.

The display lights up the heading

VALUE ?

Here two cases are also possible.

1.4.2.1. It is necessary to continue input of numbers of the body. For this it is necessary to return to point 1.3. /28

1.4.2.2. The body is fully input or it is necessary to check the input numbers of the body, in which case it is necessary to go to point 1.5.

1.5. This point is intended for movement to completion of another part of the program. Here two cases are possible.

1.5.1. For movement to completion of the second part of the program, depress the key

RUN PROGRAM

go to completion of point 2.2.

1.5.2. For out-of-order movement to completion of any other part go to point 1. of the corresponding part. For example, for movement to the fourth part (printing of the input body) successively depress the keys

STP CLEAR GTO "T" RUN PROGRAM

2. Operation with the second part of the program

2.1. For out-of-order usage of this part of the program it is necessary to depress the keys

STP CLEAR GTO "R" RUN PROGRAM

2.2. The display sights up the heading

REGISTER ?

With this three variations of program continuation are possible.

2.2.1. If it is necessary to go to the third part, not completing the second, depress the key

RUN PROGRAM

for continuation go to point 3.2.

2.2.2. If it is necessary to scan the input numbers of the body, then it is necessary to type the number of the register from which it is desired to begin the scan. Let it be necessary to scan the body beginning with the first number. We type on the keyboard the number 1 and depress the key

RUN PROGRAM

For continuation go to point 2.3.

/29

2.2.3. With the necessity of going to an out-of-order part, it is necessary to turn to point 1.5.2.

2.3. Here two cases are possible.

2.3.1. The display lights up the heading

REGISTER EMPTY

This indicates that a register was selected which is not occupied by an input body. Depress the key

RUN PROGRAM

Return to point 2.2.

2.3.2. The display lights up a number equal to the contents of the selected register. The variations of continuation are possible.

2.3.2.1. It is not necessary to change the contents of the register, in which case depress the key

RUN PROGRAM

and go to point 2.4.

2.3.2.2. In the case of the necessity of changing the contents of the register, it is necessary to type on the keyboard of the NR-9821A the needed number which must be stored in the register and depress the key

RUN PROGRAM

The old contents are replaced by the new. Go to point 2.4.

2.3.2.3. It is not necessary to continue scan of the contents of the registers, but it is necessary to go to the completion of any other part. For this it is necessary to turn to point 1.5.2.

2.4. At this point two cases are possible.

2.4.1. The display lights up the contents of the next register (the register with a number 1 greater than the preceding). For continuation, return to point 2.3.2.

2.4.2. The display lights up the heading

VALUE ?

/30

appearance of the heading is accompanied by an audio signal. This indicates that the last register of the input body was scanned and the program has moved to completion of point 1.2. It is possible to continue input of the number of the given body.

3. Operation with the third part.

3.1. For out-of-order usage of the third part of the program, successively depress the keys

STP CLEAR GTO "F" RUN PROGRAM

go to the following point

3.2. The display lights up the heading

FILE ?

awaiting the input of the number of the file selected for storage of the input body. Two variations of program continuation are possible.

If now, not typing any digit on the keyboard of the NR-9821A, the key depressed is

RUN PROGRAM

then, accompanied by an audio signal, the number is lit up equalling the dimension of the input body (in the registers). It may be useful in the selection of the file. Again depress the key

RUN PROGRAM

for continuation of the program return to point 3.2.

3.2.2. If the number of the file for the storage of the input body is selected, then it is necessary to type it on the keyboard of the NR-9821A. Let, for example, the dimension of the input body turn out to equal 73 registers and for this body we selected the file with the number 27.

We type the number 27 on the keyboard of the NR-9821A and depress the key

RUN PROGRAM

The system fixed into the calculator is listed

FILE 27

SIZE 73

for continuation go to point 3.3.

/31

In the case of attempting to select a file for information storage with a number less than 16 (files with numbers from 0 to 15 store programs) listing does not occur, but the display lights up the heading

FILE NUMBER ≤ 15

the heading is accompanied by an audio signal.

In this case it is necessary to again depress the key

RUN PROGRAM

and return to point 3.2.

3.3. After the listing of the file number and the dimension of

the body, it is still not too late to change the number of the file, if this is necessary. For this depress the key

GTO "F" RUN PROGRAM

and return to point 3.2.

If it is not necessary to change the file number, depress the key

RUN PROGRAM

After which there occurs the recording of the body on magnetic tape, cessation of the magnetic recorder and movement to completion of point 4.2. of the fourth part of the program.

4. Operation with the fourth part of the program

4.1. For out-of-order usage of the fourth part of the program it is necessary to successively depress the keys

STP CLEAR GTO "T" RUN PROGRAM

4.2. The display lights up the heading

TYPE ARRAY ?

Ascertain that the interface of the NR-11201A with the printing machine (selector code 15) is switched in to the calculator. Depress the key on the NR-9821A

RUN PROGRAM

printing of the body occurs.

/32

4.4. After listing of the input body, the display of the NR-9821A lights up the heading

END

The program is completed.

For input of a following body return to point 0.2.

REFERENCES

1. Hewlett-Packard 9821A calculator. Operating and programming manual. 1973. Hewlett-Packard company description.
2. Hewlett-Packard 9820A calculator. 11220A peripheral control. Operating manual. 1973. Hewlett-Packard company description.